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TRAFFIC STUDY
GROVE & COLUMBIAN STREETS
IN
BRAINTREE

GOVERNMENT DOCUMENTS
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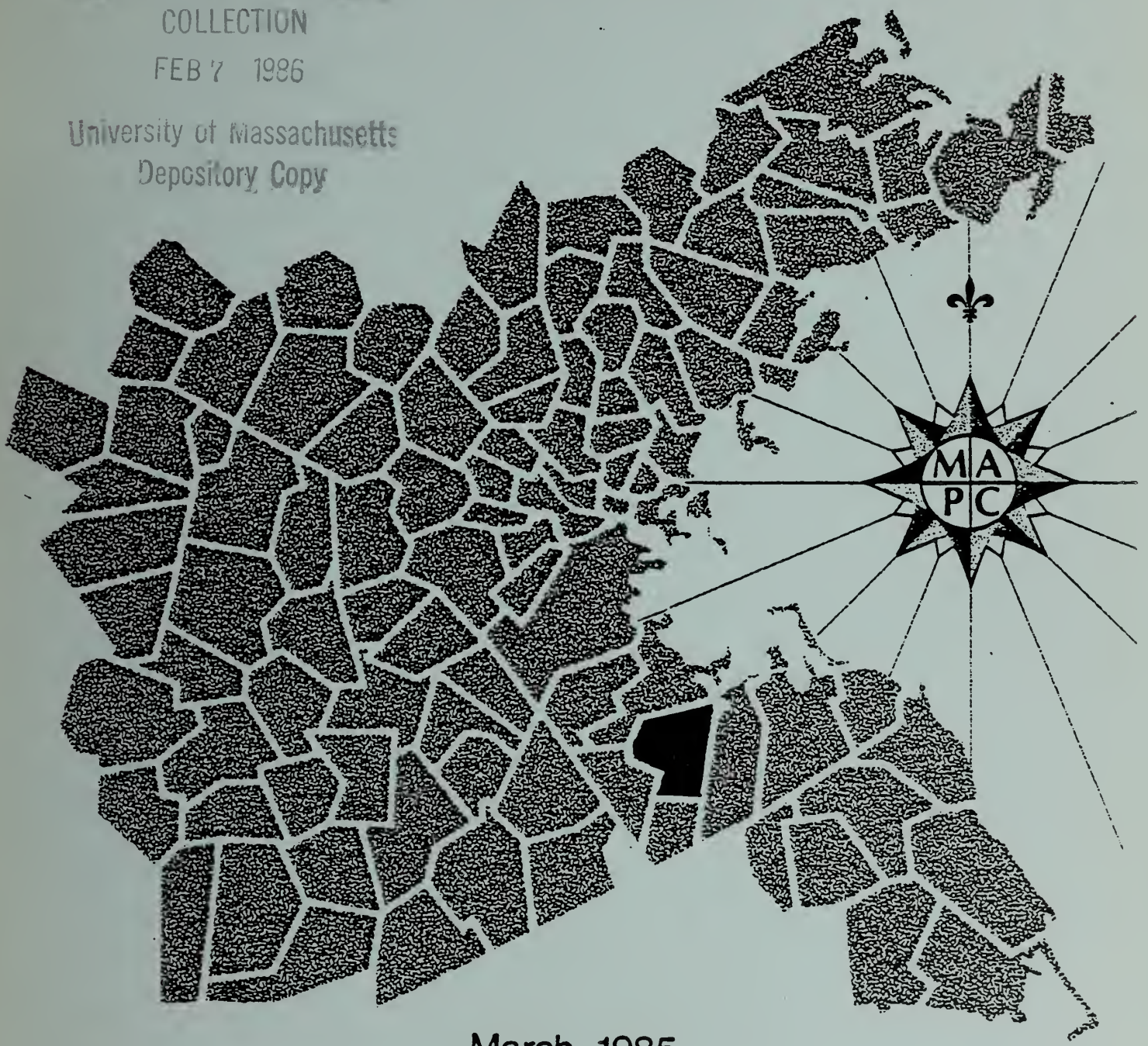

March 1985

Metropolitan Area Planning Council

110 Tremont Street Boston, Massachusetts 02108

TRAFFIC STUDY

GROVE & COLUMBIAN STREETS

IN

BRAINTREE

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Abstract

The Town of Braintree is feeling pressure for intense developement in the area of Grove and Columbian Streets. Therefore, the Town requested the Metropolitan Area Planning Council (MAPC) to estimate the traffic impacts of potential development and to outline other factors relevant to a redesign of the intersection at Grove and Columbian.

Three scenarios are developed to show alternative futures. The base case assumes no development in the immediate area but would still require expansion of the intersection to five lanes on Columbian St. The Low Traffic Scenario assumes only residential development in the immediate area and would not require much more capacity than the base case. The High Traffic Scenario assumes light industry and office space would be built on adjacent properties. This scenario includes an unrealistic amount of traffic - nine exit lanes would be required for the southern tract during the evening peak hour. Given these findings and methods the Town can now look at other scenarios which may offer a compromise between the Low and High Traffic Scenarios.

Other items for consideration in designing a new intersection include access to existing commercial properties, access to the north tract over MBTA rails, and wetlands.

This study was performed by the Metropolitan Area Planning Council as part of a community assistance program sponsored by the Federal Highway Administration (through Massachusetts Department of Public Works) and the Urban Mass Transportation Administration.

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I. Introduction

The Town of Braintree has received proposals for several projects near the intersection of Grove and Columbian Streets. It appears there is considerable pressure to develop vacant land at that location and that such development will have significant traffic impacts. In anticipation of heavy traffic impacts, much of the land in this area was recently rezoned to stipulate cluster housing. As a result the zoning of some parcels is in litigation. MAPC has been asked to look at the alternative futures for development and the implications of three scenarios with respect to the redesign of the intersection.

II. Existing Conditions

This intersection has a rural character: fairly unconfined and surrounded, for the most part, by wooded properties. Traffic is congested only in the morning peak hour.

A. Roadways

Figure 1 shows the configuration of roadways at Grove and Columbian Streets as surveyed by Louis Berger Associates. This sketch shows three separate intersection areas at the points of a grass triangular median. This separation of conflicts may be beneficial to traffic flow in that it allows fairly free movement through the intersection, but is also problematic from a safety standpoint because the opportunities for conflict occur over a wide area. Very wide pavements can have the same dual effects: increasing speed and capacity while compromising lane control and safety. The road section passing Eurasia (a restaurant) and the Braintree Stripper (furniture stripping) is shown as 44 feet wide and the roadway is not clearly delineated at the parking area there. The study by Berger also indicated the following:

1. No control of the Grove St. westbound approach
2. No stop, yield, street name, or directional signs
3. No shoulder edge lines
4. Edge of roadway not distinguishable
5. Used as a U-turn area by school busses and other vehicles
6. Traffic operates at excessive speeds
7. Poor sight distance

All of these indicate potential safety hazards.

Just east of this intersection is an at-grade rail crossing, controlled by signs, flashing lights, and bells. Current activity on this line is limited to freight services by Bay Colony.

B. Public Transportation

Carey Bus Lines serves this area with a commuter route to Boston. In the morning, four trips leave Columbia Square in South Weymouth, travelling along Columbian, Grove and Ivory Streets. In the evening, two trips return from South Station in Boston.

MBTA provides additional service from other points in Braintree. The Red Line to Boston and Cambridge stops at Union Street adjacent to Route 3, two miles from Grove at Columbian. MBTA bus routes are not convenient to this immediate area. (See Figure 2)

*Louis Berger & Assoc., Inc., Traffic Impact Study for Tek Park (Sept. 1983).

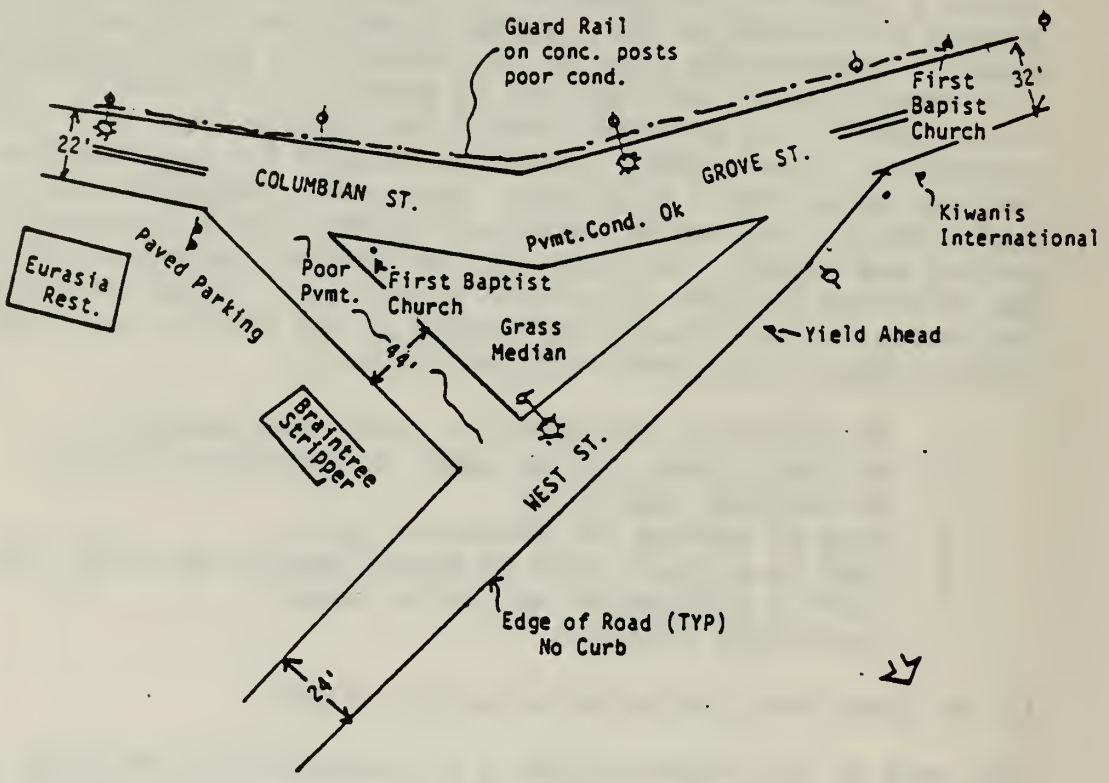


Figure 1
Configuration of Roadways

Not to Scale

Source: Louis Berger & Assoc. Traffic Impact Study for Tech Park (Sept. 1983).

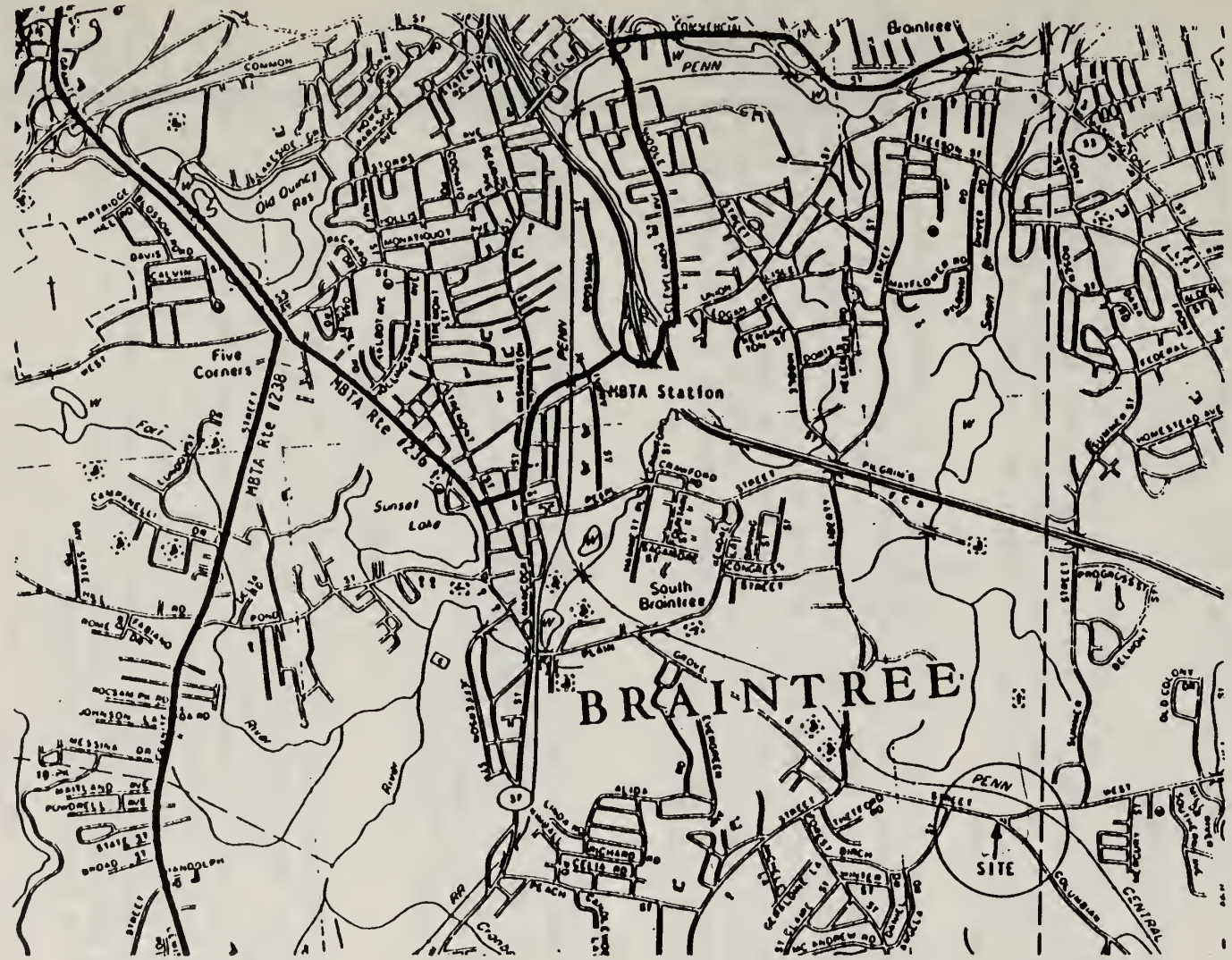


Figure 2
MBTA Bus Routes

Journey-to-work data from the U.S. Census indicates that in 1980 Braintree commuters used the following modes:

autos	84.6%
subway	12.6%
bus	2.2%
walk	0.4%
bike	0.1%
	99.9%

The fact that bus and rail ridership are significant may indicate a potential for shifting additional trips to public transportation.

C. Traffic Volumes

Commuting traffic is very heavy relative to daily traffic at this intersection. Northbound traffic on Columbian St. in the a.m. peak hour is almost twice the p.m. peak hour traffic. On Grove St., southbound traffic in the p.m. peak hour is almost four times that in the a.m. peak hour. (See Figure 3)

Traffic flow is the most difficult during the morning peak hour. The westbound approach from Grove St. (east) operates at level of service E,* with long delays. Other approaches operate at levels A and B. If the intersection were signalized, without other improvements (for 1984 traffic) traffic volumes would exceed the capacity of the intersection by 11 percent (level of service F). In the p.m. peak hour the intersection would operate smoothly at 76 percent of capacity because a large portion of the traffic passes easily southbound through the intersection, keeping to the right from Grove St. to Columbian.

D. Safety

Boston Survey Consultants, in a traffic assessment for Braintree Commerce Center earlier this year, reviewed accident data for comparison with statewide statistics.** Computed accident rates for this area compared favorably with statewide averages. It appears there is not an immediate need for safety improvements.

III. Changing Land Use

Although there are two businesses between Grove St. east of the intersection and Columbian St., most of the immediate area is undeveloped. There is however, considerable pressure for development. Anticipating fairly intense use of the land and heavy traffic impacts, the town has sought to rezone most of this land for cluster housing. But resistance from prospective developers has the zoning in litigation. Because of the uncertainty of the future development this traffic study will use two scenarios to consider the range of traffic impacts from alternative development outcomes.

*An explanation of level of service concepts is included as Appendix A to this report.

**Boston Survey Consultants, Traffic Impact Assessment: Braintree Commerce Center (Feb. 1984).

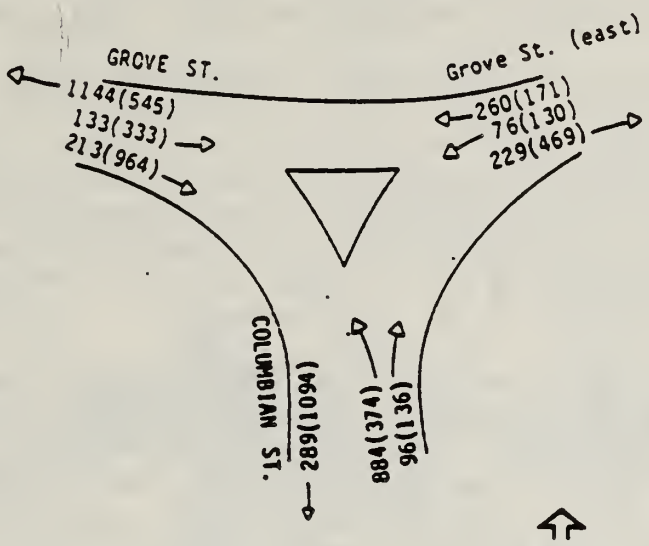


Figure 3

1983 Peak Hour Traffic
A.M. (P.M.)

Source: Boston Survey Consultants, Inc. Traffic Impact Assessment: Braintree Commerce Center (Feb. 1984)

The low traffic scenario assumes 1.00 to 1.75 units per acre of quality condominiums. The high traffic scenario assumes light industrial use and general office space, consistent with recent development proposals.

Three large areas have been identified as having the potential for new developments. A locus map from a recent traffic study by Boston Survey Consultants helps to visualize the situation, although ownership of some parcels has changed since this mapping. (See Figure 4)

For the purpose of this study, the property shown as Braintree Commerce Center is taken together with adjacent property (to the west) owned by the Braintree Rifle and Pistol Club to be Tract #1. Messina Enterprises has proposed to build the Braintree Commerce Center here: 800,000 sq. ft. of light manufacturing and industrial business. The Braintree Rifle and Pistol Club represents 60 acres with inadequate access for more intensive use. Town officials believe that this 107 acre site would ultimately contain 1,400,000 sq. ft. of floor space.

Tract #2 is taken to include 300 acres formerly owned by Tara Realty Trust, as shown on the locus map, plus approximately 200 acres owned by others. Tara Realty Trust proposed an office building of 115,000 sq. ft. on the 300 acres. Town officials feel that 20,000 sq. ft. per acre is reasonable for the 500-acre tract. This would result in a a total of 10,000,000 sq. ft of floor space.

Tract #3 is the 80-acre parcel formerly owned by Smith and Kimball. This parcel is approximately one-third wetlands, but would support 570,000 sq. ft. of light industry.

High and low traffic development scenarios for these three tracts are presented in Table 1.

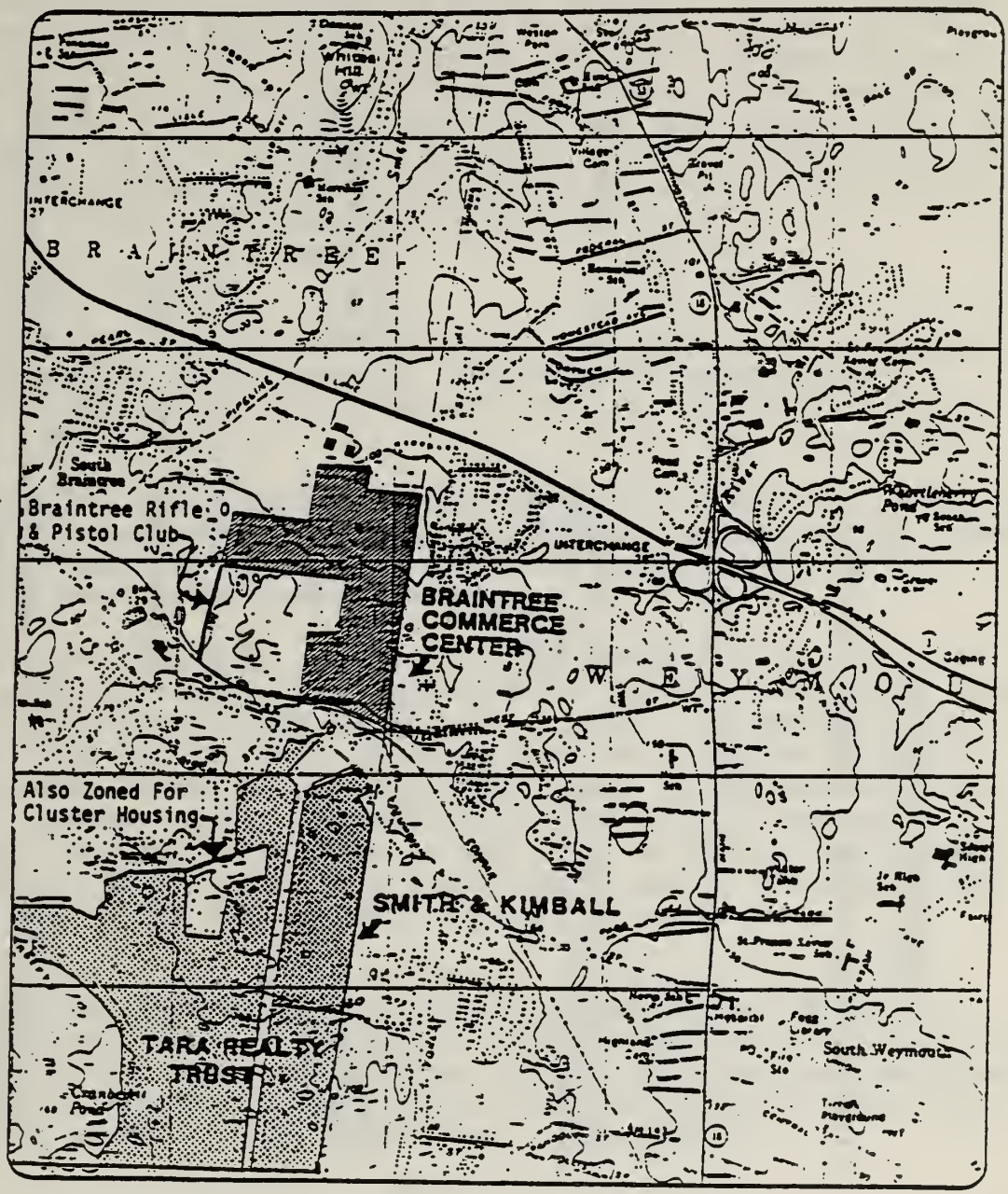

B R A I N T R E E
Braintree Rifle & Pistol Club
BRAINTREE COMMERCE CENTER
Also Zoned For Cluster Housing
SMITH & KIMBALL
TARA REALTY TRUST
South Weymouth

Figure 4
Land Developments Recently Proposed

Source: Boston Survey Consultants, Inc., Traffic Impact Assessment: Braintree Commerce Center (Feb. 1984)

Table 1

DEVELOPMENT SCENARIOS

(For Land Near Grove & Columbian Streets)

Tract	#1	#2	#3
Size	167 acres	500 acres	80 acres
Recently owned by	Messina Enterprises Braintree Rifle & Pistol	Tara Realty Trust, Arnold, Sands, Boston Edison	Smith & Kimball
LOW TRAFFIC SCENARIO			
Use	Housing	Housing	Housing
Density on Buildable Land	1 unit/25 ksf, 1.74 units/acre	150 acres @ 1 unit/acre 350 acres @ 1.75 units/acre	1.74 units/acre (1/3 is wetlands)
Housing Units	290	100+350=450	100
HIGH TRAFFIC SCENARIO			
Use	light industrial	general office	light industrial
Gross Floor Area	1400 ksf	10,000 ksf	570 ksf

IV. Traffic Forecasts

Although the intersection at Grove and Columbian does not suffer severe problems now, traffic is substantial and is expected to grow. Historical traffic counts in the South Shore area do not indicate uniform traffic growth, therefore a conservative 2 percent per year is assumed for growth of background traffic here. Even without development of the immediate area under study, traffic at the intersection will grow substantially by the year 2000, the horizon for this forecast. To quantify the effects of alternative development on the intersection, a low traffic scenario and a high traffic scenario are described and analyzed below.

A. Low Traffic Scenario

If development in the area is residential, it is most likely to be planned unit development or cluster housing. The 747 acres could sustain approximately 840 units: 290 on the north side of Grove St. and 550 on the south side.

In a planned unit development, each dwelling unit will generate about 7.8 vehicle trips, coming or going, every day. During the peak traffic hours, the expected number of departures and arrivals by automobile, (i.e. vehicle trip ends) is as shown in Table 2.

The destination of auto drivers leaving their homes, and the origin of those arriving at the site, will determine the amount of new traffic which the development will place on the adjacent streets. To determine where residents of the site are most likely to travel on a regular basis, the journey-to-work information available from federal census data has been reviewed. Journey-to-work files provide, on the basis of surveys administered to a portion of census subjects, an estimate of the numbers of residents of a given town who are employed in each of the neighboring towns, as well as the mode of travel they use to get to work.

For the purposes of this study, it has been assumed that the jobs of people living on the site would be distributed around the region in a fashion similar to those of the current Braintree residents represented in the journey-to-work data. A preliminary network assignment was performed, in which trips were distributed among the most direct routes toward their destinations. The resultant distribution is shown below.

Table 3
Low Traffic Scenario: Trip Distribution

Street (Direction of travel)	Tract #1	Tracts #2 and #3
Grove St. (west)	45%	80%
Grove St. (east)	50%	15%
Columbian St. (south)	5%	5%

Table 2

Low Traffic Scenario: Trip Generation
(trips/dwelling unit)

	Busiest Hour Between 7 and 9 a.m.			Busiest Hour Between 4 and 6 p.m.		
	Enter	Exit	Total	Enter	Exit	Total
Peak Hour Vehicle-Trips per dwelling unit*	0.1	0.5	0.7**	0.5	0.3	0.8
North Properties (Tract #1)						
Residential Units: 290						
Total peak hour vehicle-trips from Tract #1	29	145	203	145	87	232
South Properties (Tracts #2 and #3)						
Residential Units: 550						
Total peak hour vehicle-trips from Tracts #2 and #3	55	275	385	275	165	440
North and South Properties (Tracts #1,2, and 3)						
Residential Units: 840						
Total peak hour vehicle trips	84	420	588	420	252	672

* SOURCE: Institute of Transportation Engineers, Trip Generation, (1983)
**Different samples were used by ITE to determine each trip generation factor, therfore factors do not correspond exactly.

For the large number of residents commuting north to Boston and elsewhere, there is a clear choice between Route 3 interchanges. Note that residents of tract #1 are more inclined to travel east to Route 18, avoiding the intersection of Grove and Columbian Streets.

B. High Traffic Scenario

The high traffic scenario represents an extreme situation. Table 4 indicates that ten million square feet of general office space south of Columbian would have 13,600 vehicle trips leaving in the evening peak hour. Almost 15,000 new trips would be leaving these three tracts during the evening peak hour under the high traffic scenario. Compare this with approximately 2300 vehicles travelling in both directions on Columbian St. in the year 2000 (evening peak hour.)

Considering the extent of the impact this new traffic would have on local streets, the high traffic scenario is pursued here only for the sake of completeness. Appropriate distributions of traffic from light industry and office development at this location are taken from previous studies and presented in Table 5.

Table 4

High Traffic Scenario: Trip Generation

	A.M. Peak Hour		P.M. Peak Hour	
	Entering	Leaving	Entering	Leaving
Tract #1: 1,400,000 sq. ft. light industrial				
Trips per thousand Square Feet*	0.85	0.15	0.32	0.63
Total Trips	1190	210	448	882
Tract #2: 10,000,000 sq. ft. general office				
Trips per thousand square feet*	1.86	0.35	0.27	1.36
Total Trips	18,600	3,500	2,700	13,600
Tract #3: 570,000 sq. ft. light industrial				
Trips per thousand square feet*	0.85	0.15	0.32	0.63
Total Trips	484	86	182	359

*Institute of Traffic Engineers, Trip Generation (1983).

Table 5

High Traffic Scenario: Distribution of Traffic

	Tract #1*	Tracts #2 and #3**
Grove St (west)	36%	6%
Grove St (east)	42%	19%
Columbian St.	22%	75%

* Source: Boston Survey Consultants, Traffic Impact Assessment: Braintree Commerce Center (Feb 1984)

SOURCE:
** Louis Berger & Assoc., Traffic Impact Study for Tek Park (Sept 1984).

V. Capacity Requirements

For purposes of comparison, the capacity requirements for the low traffic and high traffic scenarios are presented following a comparable analysis for the base case (traffic in the year 2000 without new development.) These three scenarios provide a complete range, with the high traffic scenario being more than the surrounding street system could possibly bear.

A. Base Case

Traffic in the year 2000, given no further development of the tracts under study, would be as shown in Figure 5. Without signalization traffic entering the intersection from Grove St. east and eastbound traffic turning into Grove St. would suffer very long delays during both peak hours. If the existing layout were signalized, all traffic in the intersection would experience level of service E*, with intersection volumes exceeding intersection capacity by 59 percent in the morning peak hour. The capacity of the intersection could be increased to an acceptable level (see figure 6) by providing:

- o two through lanes and a left-turn lane for Grove St. eastbound (EB)
- o two through lanes and a right-turn lane for Columbian St. northbound (NB) to Grove St. (east)
- o a two lane approach (for left and right turns) on Grove St. westbound (WB), and
- o right-turn-on-red for Grove St. WB

Given this configuration, traffic would experience level of service C in the morning peak hour (76% of capacity) and level of service B in the evening peak hour (69% of capacity) at the intersection. Grove St. (west) and Columbian are two-lane roadways now and would operate at level of service E during both peak hours. If Grove St. west and Columbian St. were widened to four lanes, flow would be at level of service C to D beyond the intersection.

B. Low Traffic Scenario

Traffic to and from new development at this intersection will add to the burden on this intersection. Figure 7 shows the low traffic scenario for the year 2000.

In order to accommodate the low traffic scenario, the configuration offered above for the base case can be augmented by a lane to allow right turns from Grove St. WB to bypass the intersection (see figure 8). Grove St. west and Columbian St. would be widened to four lanes beyond the intersection. The result would be level of service C in the morning and evening peak hours.

*An explanation of the level of service concepts is included as Appendix A to this report.

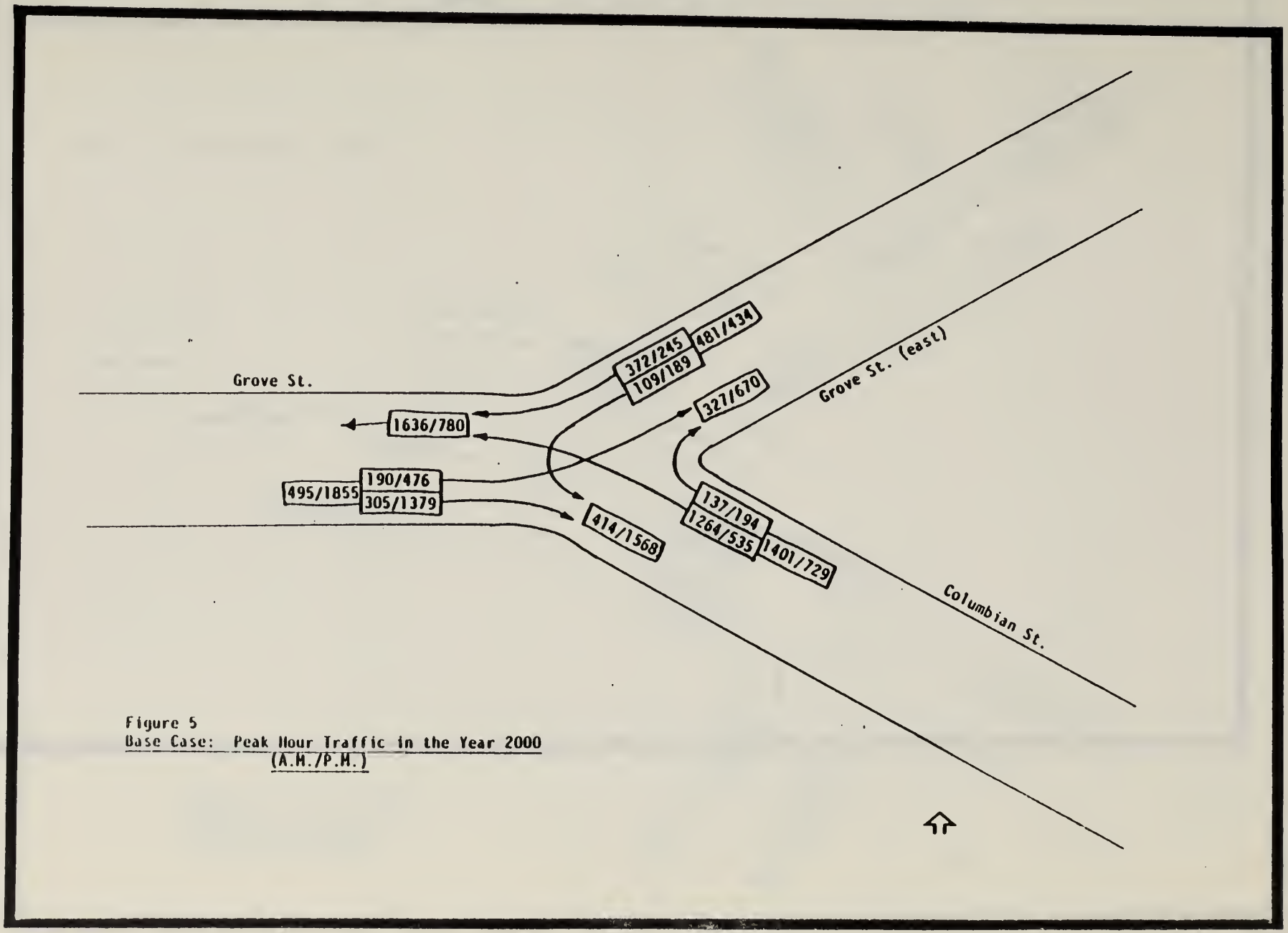
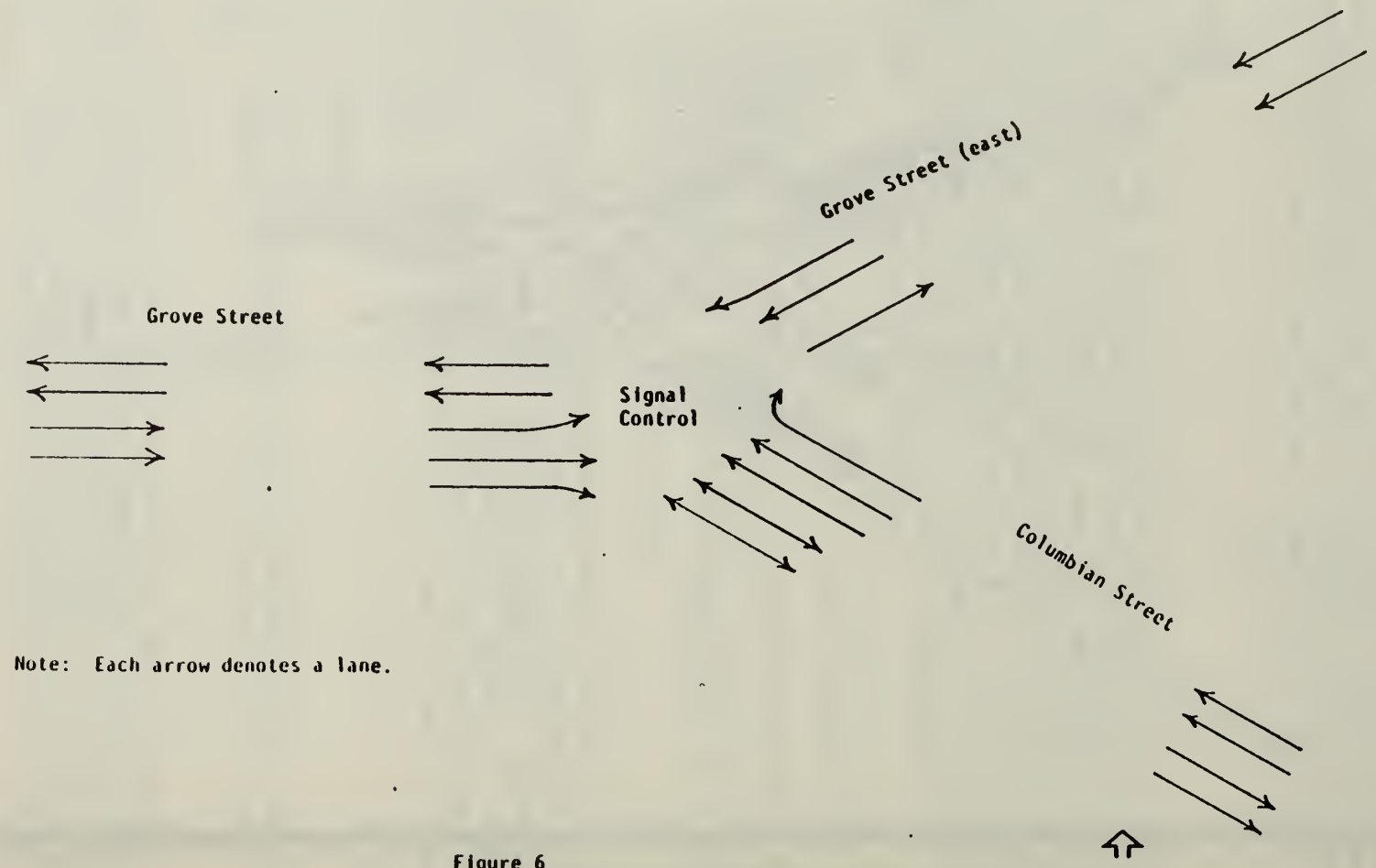


Figure 5
Base Case: Peak Hour Traffic in the Year 2000
(A.M./P.M.)



Note: Each arrow denotes a lane.

Figure 6
Lane Configuration for Base Case in the Year 2000

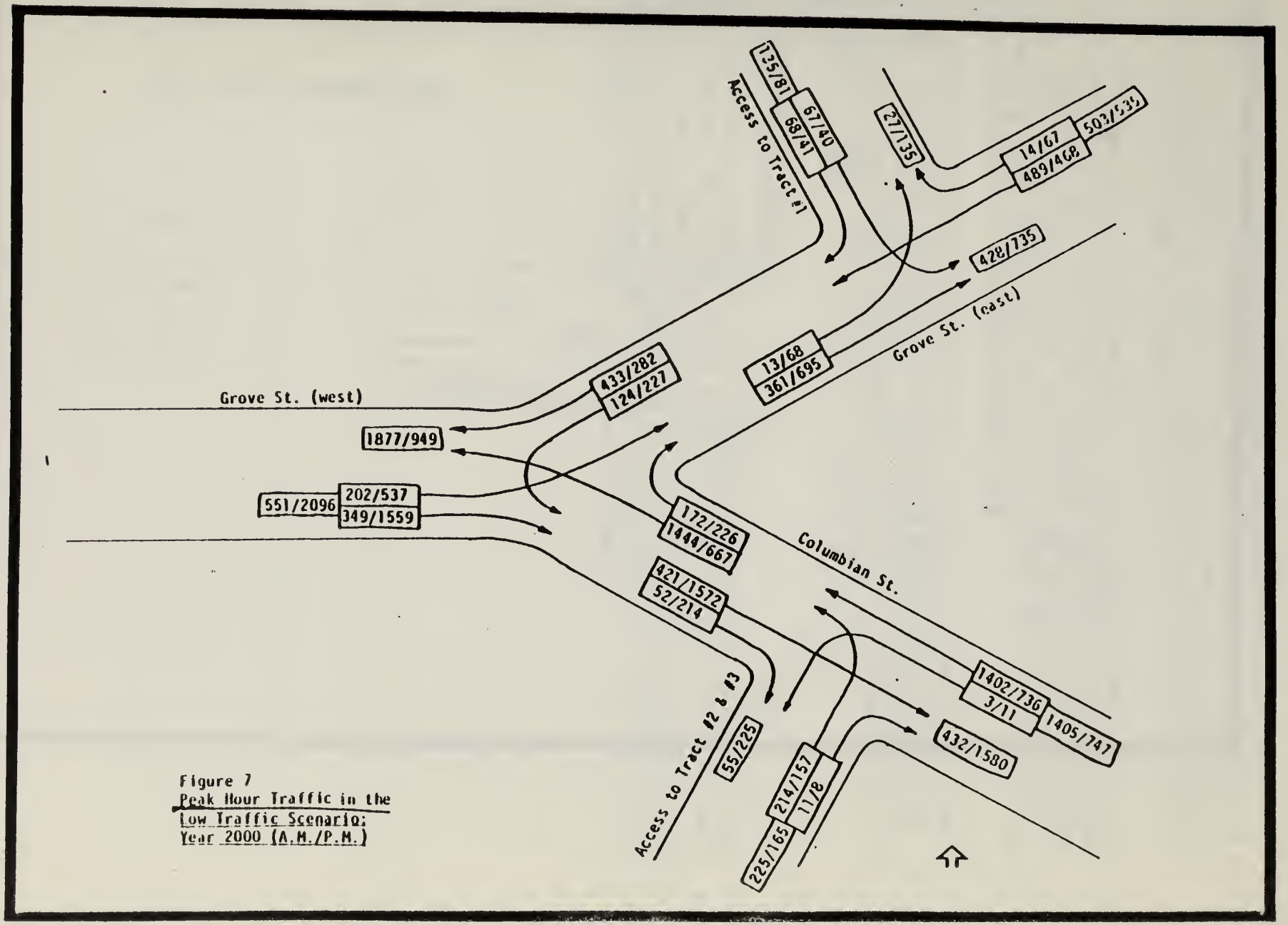


Figure 7
Peak Hour Traffic in the
Low Traffic Scenario:
Year 2000 (A.M./P.M.)

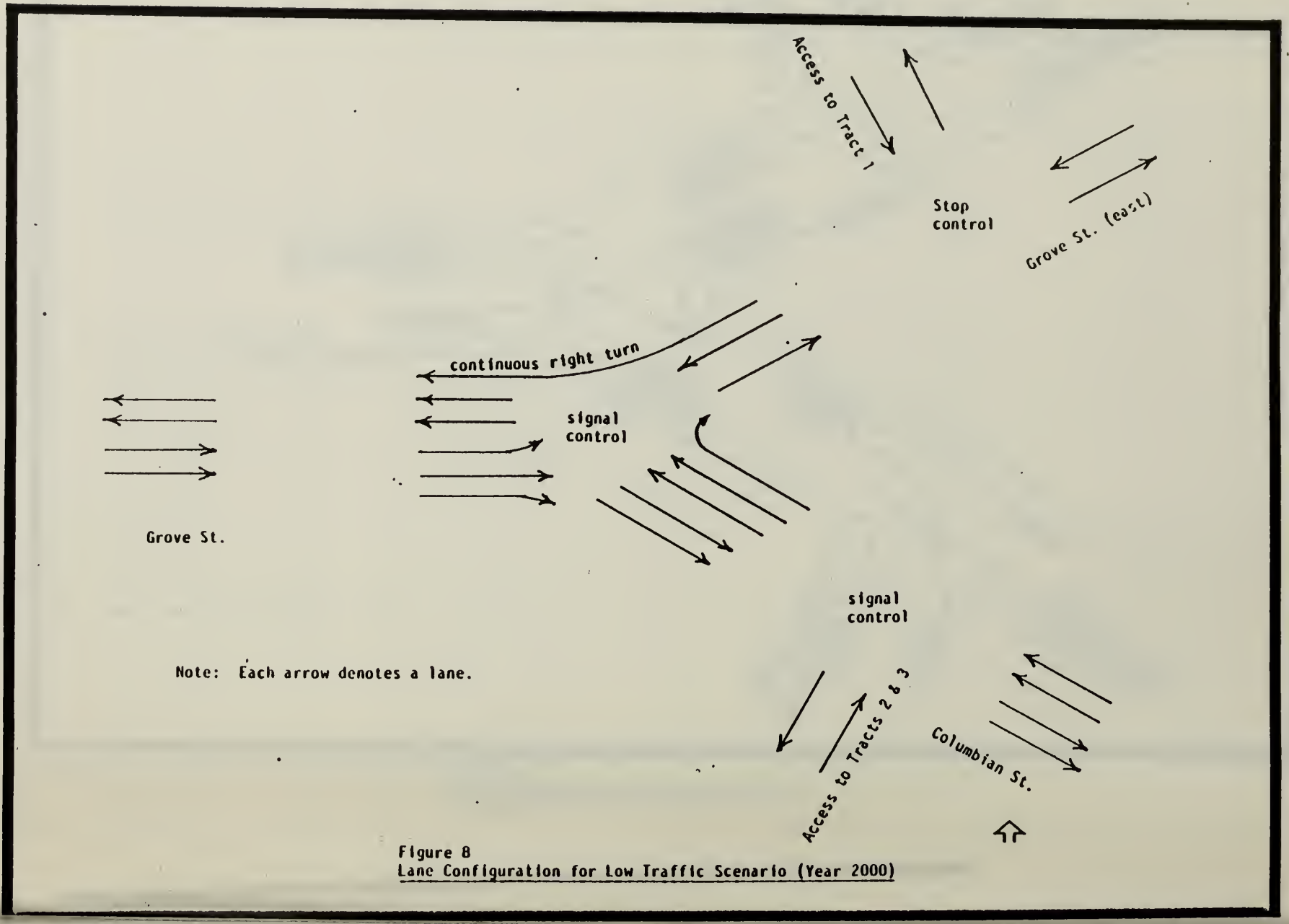


Figure 8
Lane Configuration for Low Traffic Scenario (Year 2000)

At the entrance to Tract #1, an unsignalized intersection would be adequate. With a reserve capacity of 162 vehicles, the exit from Tract #1 in the morning peak hour would provide level of service D. But even though vehicles exiting Tract #1 in the morning would experience delays, Grove St. traffic would be largely unaffected.

At the intersection of Columbian St. with the access to Tracts #2 and #3 traffic would be much heavier and would require signalization to operate at an acceptable level of service. Assuming two lanes in each direction on Columbian and a one-lane exit from Tracts #2 and #3, the signalized intersection would offer level of service B in the morning peak hour and level of service C in the afternoon peak hour.

An alternative configuration, drawn up by the town engineering department, is to bring together the access to developing properties and the three streets at four-way intersection. This simplifies traffic movement on Columbian St. but worsens the situation on Grove St. (east) under the Low Traffic Scenario. This alternative is addressed in Appendix B.

C. High Traffic Scenario

The high traffic scenario is not a realistic alternative, given the local street system. The almost 14,000 vehicles leaving tracts #2 and #3 would require at least nine lanes, during the afternoon peak hour, to exit. To specify a configuration at Grove and Columbian Streets to accommodate this traffic would not be worthwhile unless the entire local street system were to be rebuilt to serve this very large development.

VI. Design Considerations

It is clear from the preceding capacity analysis that the intersection of Grove and Columbian Streets will require increased capacity to serve traffic anticipated by the year 2000, whether or not the abutting properties are developed. For each of the scenarios, required capacity has been described in terms of peak hour volumes and also numbers of lanes required for each movement. In developing alternative designs, there are other considerations as well.

Access to existing commercial properties and potential new developments is of primary importance. If the intersection of Grove and Columbian Streets is relocated to offer better flow through the intersection and easy access to new developments, access to the Braintree Stripper (furniture stripping business) and Eurasia (restaurant) must be provided. Access to new developments is clearly a concern and offers a challenge given the constraints of other items discussed below: wetlands, grade separation at rail crossing, and residential neighborhoods.

Wetlands in the area are seasonally saturated, and currently forested with broad-leafed deciduous trees. Widening of Columbian St. on the south side or access to the south property through these wetlands would reduce the wetland area and change the area's drainage.

The rail crossing, now at grade, should be evaluated as a grade-separated rail crossing. Currently this rail line carries only a small amount of freight traffic for Bay Colony; however, there maybe increased usage in the future. In the short run, Braintree will likely add two trips a day for waste transfer from the existing incinerator. In addition, a recent South Shore Rail Study has proposed this line, the Greenbush Line, as one of three alternatives for commuter service to the South Shore. With one exception, other rail crossings along the rail line in Braintree are grade-separated and the Town is interested in preserving this valuable rail line.

This line is owned by MBTA and is leased by Bay Colony through the Executive Office of Transportation and Construction (EOTC). Any redesign of the crossing would need to be reviewed by the Department of Public Utilities, MBTA, and EOTC.

Residential neighborhoods abutting developable land at this location prevent "back-door" access to the properties under review.

After these constraints, there is one final consideration: the land near the intersection between Grove St. and the railroad is publicly owned, by the town electric utility. This may prove helpful in the development of feasible alternatives to increase capacity and provide access to new development.

An improved design for this intersection will be important to property owners in the area, to prospective developers, and to the towns of Braintree and Weymouth; these parties should be included in the planning effort. In addition, developers should be required to contribute to the cost of necessary improvements. Although Grove and Columbian Streets are eligible for Federal Aid Urban Systems funding, that funding source is oversubscribed, therefore this project would require both local and private funds.

VII Conclusions

The analysis presented above suggests that capacity would need to be increased for any of the scenarios reviewed. In addition, the high traffic scenario is inappropriate and confirms the need for a master plan. And, finally, the intensity of traffic suggests serious consideration of measures to increase auto occupancy and to induce shifts to other modes such as vanpool and bus. In addition, application of variable work hours will reduce peak hour traffic and extend the peak period.

The low traffic scenario indicates that the intersection should be redesigned to provide increased capacity and to provide access for new residential developments. In this case the intersection should maintain the current alinement and should be signalized. Grove St. should be widened to four lanes west of the intersection plus a left turn lane at the intersection. Columbian St. should be widened to four lanes plus a right-turn lane at the intersection. Grove St. east would be widened to include a left-turn lane at the intersection and a ramp to allow right-turning vehicles to bypass the intersection completely. The Grove St. rail crossing should be grade separated and should be designed to allow access to the north properties. Given the joint efforts of prospective developers and the public sector, this solution appears reasonable.*

The high traffic scenario appears to have substantial impacts and therefore maybe entirely inappropriate. The level of development proposed would overwhelm the local street system. This scenario confirms the need for the Town of Braintree to pursue a master plan. The master plan currently being developed by Connery Associates will provide a broader view of development and infrastructure in Braintree and will indicate what type and level of land use is appropriate for the area at Grove and Columbian.

Given the level of commuting traffic anticipated in this area, it is also appropriate that Braintree begin to foster ridesharing and to plan for new or expanded public transportation. The town should consider a zoning ordinance which would require that any proposal for development include a review of the potential for, and benefits from, increased vehicle occupancy. And if that analysis indicates there is an opportunity for improvement, the developer should present a program to encourage ridesharing and/or subsidize high-occupancy vehicles. With respect to public transportation, the MBTA rail line presents and excellent opportunity for passenger service to Boston given the reconstruction of the Neponset River bridge. Possibly, the property between Grove St. and

*The Low Traffic Scenario does not require much more than the base case (traffic in the year 2000 with no new development on the tracts reviewed here). Only the right-turn ramp for Grove St. east would not be necessary for the base case.

the tracks is an appropriate location for a station. An evaluation of public transportation for Braintree should consider that possibility and develop appropriate plans. Clearly, there are both and short-term long-term initiatives to be taken in reducing the share of commuters travelling to work alone, by automobile.

Appendix

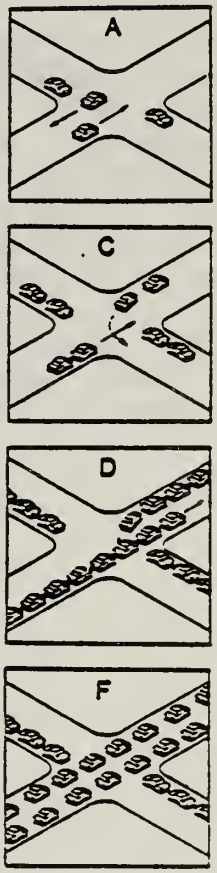
A. Level of Service

B. Four-way Intersection @ Grove & Columbian

Appendix A

Level of Service

L.O.S.	ROADWAY SEGMENTS OR CONTROLLED ACCESS HIGHWAYS	INTERSECTIONS
A	Free flow, low traffic density.	No vehicle waits longer than one signal indication.
B	Delay is not unreasonable, stable traffic flow.	On a rare occasion motorists wait through more than one signal indication.
C	Stable condition, movements somewhat restricted due to higher volumes, but not objectionable for motorists.	Intermittently drivers wait through more than one signal indication, and occasionally backups may develop behind left turning vehicles, traffic flow still stable and acceptable.
D	Movements more restricted, queues and delays may occur during short peaks, but lower demands occur often enough to permit clearing, thus preventing excessive backups.	Delays at intersections may become extensive with some, especially left-turning vehicles waiting two or more signal indications, but enough cycles with lower demand occur to permit periodic clearance, thus preventing excessive back-ups.
E	Actual capacity of the roadway involves delay to all motorists due to congestion.	Very long queues may create lengthy delays, especially for left turning vehicles.
F	Forced flow with demand volumes greater than capacity resulting in complete congestion. Volumes drop to zero in extreme cases.	Backups from locations downstream restrict or prevent movement of vehicles out of approach creating a storage area during part or all of an hour.



Sources:

1. AASHTO, A Policy on Design of Urban Highways and Arterial Streets (1973, based on material published in Highway Capacity Manual, HAS, 1965)

2. Wilbur Smith and Assoc., How to Limit Traffic Congestion in Your Community (1984, prep. for the Housatonic Valley Council of Elected Officials, Brookfield Ctr., Conn.

Appendix B

Four-Way Intersection @ Grove & Columbian Streets

This alternative has the advantage of bringing together all conflicts with Columbian St. traffic as shown in Figure B-1. Lane requirements are similar to those for the existing configuration (at least one lane more for each approach than is shown in Figure B-1).

East of the intersection however, this alternative suggests a realinement of Grove St. (east) to give the access to Tract #1 a through movement and to make Grove St. (from Weymouth) the minor approach at the new T-intersection. The major flow through this minor intersection is along Grove St. rather than to and from the access drive. Therefore, the existing line for Grove St., with the access drive meeting Grove St. in a T, is preferred. With one lane for each approach on Grove/West and one lane exiting Tract #1, this location could operate satisfactorily without a signal. Strictly speaking, vehicles leaving Tract #1 would experience delays during the peak hour, in spite of a reserve capacity of 162 vehicles during the peak hour. Maintaining West-Grove St. as a through movement will also avoid a very awkward movement with westbound traffic coming into Grove St. from the left and then crossing to the outside (right) lane. Because under the Low Traffic Scenario development traffic is not the major flow, the existing configuration is preferred.

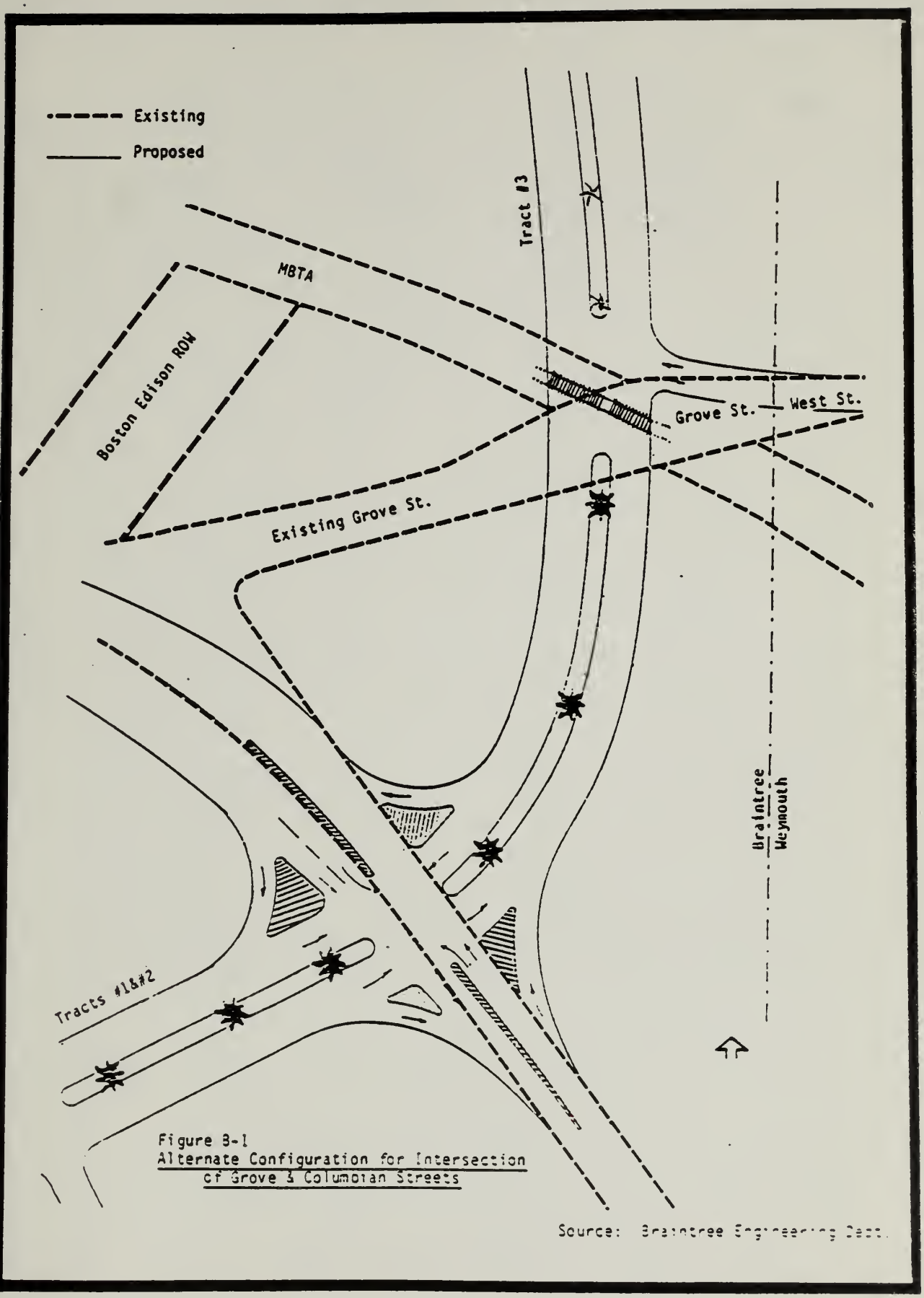


Figure B-1
Alternate Configuration for Intersection
of Grove & Columbian Streets

Source: Braintree Engineering Dept.